UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

Project	Date	Author

TITLE

REPORT OF THE 1945 MOUNTAIN PINE BEETLE CONTROL PROJECT IN THE WHITE RIVER RANGER DISTRICT, MOUNT RAINIER NATIONAL PARK

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Portland 5, Oregon
August 31, 1945

SUBJECT—

INDEX NO.—

U.S. GOVERNMENT PRINTING OFFICE 8—9742

REPORT OF THE 1945 MOUNTAIN PINE BEETLE CONTROL PROJECT

IN THE

WHITE RIVER RANGER DISTRICT, MOUNT RAINIER NATIONAL PARK

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INTRODUCTION

In keeping with the previously established forest insect control policy of Mount Rainier National Park (the control of insect outbreaks in areas of highest recreational use) and on the recommendations of this Bureau, it was deemed advisable to resume direct control operations against the mountain pine beetle (Dendroctonus monticolae Hopk.) during the spring of 1945 in the White River Ranger District. This project was designed to control the mountain pine beetle populations that had been building up gradually since the cessation of control work in 1942. The first trees were treated on May 7 and the last on June 20, 1945.

The principal method of control was with a penetrating oil sprayed on the bark of the felled infested trees. The use of this method had been successfully demonstrated on previous control projects against the same beetle on the Wasatch National Forest, Utah and the Coeur d'Alene National Forest, Idaho. In some cases former methods of treating infested trees - the fell, peel, or burn method - were used; however, the biggest percentage of trees treated were sprayed with the penetrating oil.

Acknowledgement is hereby made of the excellent work performed by the 12-man Civilian Public Service crew on the 1945 project. Each man worked hard to do the task assigned to him to the best of his ability. The willingness of these men to work longer hours than were expected, or to stay with a difficult task until it was finished, made it a pleasure for the Project Superintendent and the writer to participate in this project. The success of the 1945 project can be largely attributed to these men.

DESCRIPTION OF THE CONTROL AREA

The White River Control Area lies in the northeastern portion of the Park and comprises the forested areas in the following drainages: White River, Yakima Creek, Fryingpan Creek, Wright Creek, Shaw Creek, Klickitat Creek, Deadwood Creek, and Crystal Creek. Forest cover is a mixed coniferous stand characteristic of the wet climate of the Pacific Northwest. Although the dominant tree species are Douglas fir, we were concerned with the lesser species, namely western white pine, white bark pine, lodgepole pine, and Engelmann spruce growing in the subalpine and alpine zones. Of these, western white pine is the most important. The terrain is moderately rough and the slopes are very steep.

The elevations in the treating areas ranged from 3,500 to 6,200 feet. For the most part the area is free of the dense underbrush found in most westside forests. Camp was established at the White River Ranger Station and all trees were treated from this base camp.

HISTORY OF PAST CONTROL WORK ON THE AREA

The past history of forest insect conditions and control work against the mountain pine beetle in the White River Control Area is to be found in considerable detail in the several reports by members of the Forest Insect Laboratory and in the annual reports by the Chief Ranger of Mount Rainier National Park and there is no need to review these at this time. Direct control operations against the mountain pine beetle in the White River Area date back to 1931, although some control work was done in other districts of the Park in 1925. Since 1931, control measures have been conducted annually on the White River Area except for the years 1935 and 1938 when no infested trees were spotted and 1943 and 1944 when man-power shortages made control work impossible. A total of 1157 trees have been treated since 1931 and an additional 680 trees estimated in need of treatment in 1943 and 1944. Practically all of these have been western white pine. A tabulation of this control work is as follows:

Year	Number of Trees Treated	Number Estimated Not Treated
1931	524	
2	150	
3	2	
4	61	
5	0	
6	12	
7	6	
8	0	
9	34	
1940	96	
1	132	
22	140	
3		280
4		400
Total 14	1157	680

1945 CONTROL PROJECT

The general plan for the 1945 mountain pine beetle control project was much the same as other pine beetle projects undertaken in this region. Although it was set up primarily as a penetrating oil spraying project, some of the infested trees were peeled and others were decked and burned. On many trees a combination of these three

methods was used to achieve the objective of the project - the destruction of mountain pine beetle populations. The percentage of the total infested length of the trees treated by these three methods is as follows:

Infested length sprayed with oil	- 61.0%
Infested length peeled	- 24.1%
Infested length burned	- 14.9%
Total	100%

Project Supervision

Chief Ranger W. W. Yeager was in administrative charge of the project. Equipment, supplies, and materials were furnished by the Park Service. The compressed air sprayers used in this work were borrowed from the Grand Tieton National Park and from the Forest Insect Laboratory, Coeur d'Alene, Idaho. Labor was supplied by a Civilian Public Service crew of 12 men transported by the Park Service from the main camp in Sequoia National Park. One man was assigned to assist the cook, leaving a total of 11 men for the treating work. Mr. C. Hamilton, Park Service employee, served as Project Superintendent until June 15. The Park Service also employed a cook (Mr. G. Smith, May 1-31, and Mrs. R. Curtis, June 1-20) and ran the mess for the project. Mr. R. Anderson and Mr. H. Boardson, Park Service employees, rendered valuable assistance in clearing the snow from the road to and beyond the White River Bridge. Without their help the project could not have been completed on schedule. Mr. R. L. Furniss, Mr. W. J. Buckhorn, and the writer, of the Forest Insect Laboratory, Portland, Oregon were responsible for the technical phases of the field work such as locating and marking the infested trees, methods and success of treatment, etc. Mr. Furniss had arranged the details of the project with Mr. Yeager and had planned to supervise the actual treating work; however, due to the pressure of other work, was unable to be on the area except for the first three days. The writer acted in his stead. Mr. R. Birkey, Leader of the C. P. S. crew, acted as Straw Boss and was given the responsibility of measuring the treated lengths of all trees. Close cooperation existed between all the men involved in this undertaking and every effort was directed toward its success.

Spotting of Infested Trees

Practically all of the trees to be treated during the project were located, blazed, and numbered by Furniss and Buckhorn in September 1944. They were located primarily by general reconnaissance from vantage points along roads, trails, and hill sides and by their proximity to red-topped trees of the previous year. The diameters of all trees were taken with a diameter tape. The trees to be treated were difficult to locate because of the absence of the characteristic fading foliage and the spotters had to examine individual trees for evidences of pitch tubes on the basal portion of

the trunks. The remainder of the trees treated were spotted by the writer with the assistance of Mr. R. Hirchberger, one of the C. P. S. crew, after the project began. The number of trees treated during the project is shown in Table 1 by species and by infestation groups.

TABLE 1. NUMBER AND SPECIES OF TREES TREATED BY GROUPS

Group	Western White Pine	White Bark Pine	Lodgepole Pine	Ponderosa Pine	Engelmann Spruce	Total
A		40				40
B		2				2
F		4				4
H	26		1			27
L	1		1			2
M	52					52
Q	30					30
S	52					52
T	5					5
U	31				3	34
V	80					80
W	29					29
X	40					40
Y	25				1	26
Z	38		1	1		40
AA			6		1	7
BB	2				1	3
CC	1					1
DD	1					1
EE	4					4
FF		14				14
GG		23				23
Total	417	83	9	1	6	516
Percent of Total	80.8%	16.1%	1.8%	0.1%	1.2%	100%
Average No. Trees in Group	26.1	16.6	2.2	1.0	1.5	23.5

Treating Crews

Because of the difficulty of transporting oil to the infested group of trees, the entire treating crew (an average of 9 men per day) usually went to one group and worked on that group until all the trees had been treated. The men were divided into two crews of 4 or 5 men each with a set of fallers, a sprayer and his helper with each crew. The remainder of the crew together with the fallers prepared the tree for treatment after it was felled.

It was fortunate that no accidents occurred during this project. The men were not equipped with the proper boots and experienced considerable difficulty in climbing the steep snow-covered or bare slopes carrying tools plus five gallons of oil. One of the C. P. S. crew, Mr. L. Keim, suffered an attack of appendicitis and was confined to bed for over a week. This was the only illness reported during the project.

Spray Formula

Orthodichlorobenzine	1 part by volume
Fuel oil	4 parts by volume

No other combinations of these ingredients were tried during this project. The ortho was delivered at White River Ranger Station in four 55 gallon drums. The fuel oil was drawn from a large storage tank at the Station after authority had been given by the Office of Price Administration for its use and replacement. A small platform was constructed to hold the drums of ortho.

Preparation of the Spray Mixture

The mixing of the two ingredients was done entirely by two of the crew under the supervision of the writer. The ortho and fuel oil were drawn off in five gallon pails and poured into an open end 55 gallon drum. Two of these drums were used to mix the spray. When 25 gallons of the mixture had been drawn, it was stirred vigorously with a wooden paddle and, while stirring, was drawn off into 5 gallon "Jeep" cans. During the mixing process, the fuel oil and the final mixture were strained through a fine screen (80 mesh per inch). The fuel oil was strained as it came from the storage tank; the mixture was strained as it came from the mixing drum and again when it was poured into the Jeep cans. This effort was rewarded by not having to clean the pressure sprayers during the treating work because a considerable amount of foreign material was removed at each straining.

Transportation of the Spray Mixture

A battery of 20 Jeep cans was used to carry the oil spraying mixture to the treating areas. They were carried by truck to the base of the slope near a group and then placed on pack boards and carried on the backs of the men to the trees. Seldom was it possible to carry enough oil to a group to last one day. Because of the steep terrain, more than one trip per day for oil was not warranted. This accounts for the fact that parts of trees were oiled and parts peeled in order to make full use of the men and time available for treating.

Weather Conditions

Although it was assumed that weather conditions would be an important factor in the effectiveness of the oil spraying project, detailed records were not kept at White River Ranger Station. An indication of the weather during May can be obtained from the official Weather Bureau substation record at Greenwater, which is the nearest substation to the Ranger Station.

Weather Record for May 1945

Station - Greenwater
Elevation - 1,708 feet
Mean Temperature - 51.5 degrees
Precipitation - 3.41 inches
No. of days with precipitation 0.01 or more - 17 days
Number of clear days - 9 days
Number of days partially cloudy - 2 days
Number of cloudy days - 20 days

In general the weather at White River was probably typical for the months of May and June. It was planned to stop treating on rainy days or on days when the men could not get into the woods. Three full days were lost because of rain. On several other days, treating was hampered because of light showers and low-hanging fog banks. Throughout the project only those trees that could be treated during a single day were felled and prepared for treatment. This was to avoid having trees on the ground which might get wet during the night.

When the project began, most of the treating area was covered with deep snows which made treating and transportation difficult. The snow melted rapidly in the more exposed situations but persisted throughout the project in many parts of the area. The Summerland area, White River Park, and the Sunrise Ridge sections were still covered with snow when the project closed and it was impossible to drive the truck further than an eighth of a mile from Yakima Creek. A snow-cat was used to transport the men and tools to Sunrise Point and to carry the spray mixture down the old road along White River.

The presence of snow added to the difficulties of this project in several ways: (1) The daily temperatures for the most part were low which retarded the lethal action of the ortho, (2) Travel to and from the groups of infested trees was slow and difficult, (3) Special precautions had to be taken to keep the infested trees from burying in the snow when felled or rolled. Snags, brush, and tops of trees were laid in the path of trees to be felled and in many cases trees were felled across each other to keep them off the snow.

STATISTICAL SUMMARY OF THE 1945 PROJECT

The primary objective of the 1945 project was the destruction of mountain pine beetle populations. While it would be interesting to compare the costs of the 1945 project with other methods of control, such a comparison is difficult to make because of the factor of labor. A summary of the accomplishments of the 1945 project will be given in the following sections.

Number and Species of Trees Treated

The number of trees treated during this project is given in Table 1 by species and infestation groups. A total of 516 trees were treated in 22 groups which averaged 23.5 trees per group. Of the total trees, 417, or 80.8% were western white pine; 83, or 16.9%, were white bark pine; 9, or 1.8%, were lodgepole pine; 6, or 1.2%, were Engelmann spruce; and 1, or 0.1%, was ponderosa pine. The infested trees were found singly and in groups of from 2 to 80 trees. Most of the groups were adjacent to trees killed during the previous year or were close to older groups of treated trees. The locations of the groups of trees treated are shown on Map 1.

Diameter Classes of Trees Treated

All the trees treated during this project were measured in one inch classes with a diameter tape at breast height. The distribution of these classes by infestation groups is shown in Table 2. The trees ranged in diameter from 4 inches to 27 inches DBH and averaged 12.7 inches. Western white pine averaged 12.9 inches, white bark pine averaged 12.2 inches, lodgepole pine averaged 11.6 inches, Engelmann spruce averaged 13.7 inches, and the ponderosa pine was 13.0 inches DBH.

TABLE 2. DISTRIBUTION OF TREATED TREES 1/ BY GROUPS AND DIAMETER CLASSES

DBH (Inches)	A*	B*	F*	H	L	M	Q	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD	EE	FF*	GG*	Total
4																						2	2
5											1					2							3
6								3			6		1	3			1					2	16
7	1			2				6			8	1	4	3								1	26
8	7					8	1	7		1	6	1	2	1								2	36
9	4		1	2		5	1	6	2	1	8		4	3	2	1				1	1	1	43
10	4			2		6	2	2		2	9	3	8	1	1						1	3	44
11	7	1	1	3		7	3	6		3	10	2	3	1	1				1		2	1	52
12	3			5	1	3	5	5	1	4	10	2	3	1	2	2					1	5	53
13	7					4	1	3		5	9	3	1	2	5	1					1		
14	3			2		3	2	4			8	3	4	1	4		1				2	2	39
15					1	5	4	4		2	4	3	4	3	5							2	37
16	1		1	1		4	3	2	1	4	1	2	1		4		1					1	27
17	2	1		2		3	2	2	1	3		2	2		4	1				1			26
18				3		1	3	1		5		1			7						1	1	23
19			1	1		2	1	1		2					2					1	1		12
20				1		1				1		3			3					1			10
21				2			2			1		1	2								1		9
22				1								2			1			1					5
23													1	3	1						2		7
24	1																				1		2
25																							
26														3									3
27														1									1
Total	40	2	4	27	2	52	30	52	5	34	80	29	40	26	42	7	3	1	1	4	14	23	518
Average	11.5	14.0	13.8	14.1	13.5	12.3	14.3	11.0	12.6	14.6	10.5	14.7	12.0	14.1	15.9	10.4	120	22.0	11.0	16.2	15.9	10.7	12.7

1/ Groups marked by * contain only white bark pine. Most of the other groups contain only western white pine; however, a total of 9 lodgepole pine, 6 Engelmann spruce, and 1 ponderosa pine are included in the data for groups H, L, U, Y, Z, AA, BB

Infested Lengths of the Trees Treated

The linear feet of the trees treated during the 1945 project is given in Table 3 by species, infestation groups, and by method of treatment. A total of 26,907 linear feet was treated; 16,339, or 61.0% oiled, 6,543, or 24.1% peeled, and 4,025, or 14.9% burned. Western white pines made up 86.8% of the total length treated, white bark pine 10.6%, lodgepole pine, 1.3%, Engelmann spruce 1.1%, and ponderosa pine 0.2%. The infested lengths of the treated trees ranged from 12 feet to 115 feet and averaged 52.1 feet per tree.

Oil Spraying Materials

The amount of orthodichlorobenzine and fuel oil used during the 1945 project and the degree of coverage of this mixture is as follows:

Spray materials used - Orthodichlorobenzine	115 gallons
Fuel oil	460 gallons
	575 gallons

Number of trees sprayed (approximate)	314 trees
Gallons of spray per tree	1.83 gal. per tree
Gallons of ortho per tree	0.36 " " "
Gallons of fuel oil per tree	1.47 " " "
Cost of spray per tree	$0.52 per tree

It is a bit difficult to determine the exact amount of spray used on individual trees or the number of trees sprayed. Records were kept as to the total amount of spray used in any one group of trees. This matter is further complicated by the fact that parts of trees were sprayed and parts peeled or burned. The 314 trees, indicated above, were obtained by dividing the total linear feet sprayed by the average treated length per tree.

Man-Days of Work

A total of 290 man-days of productive labor are directly chargeable to the 1945 project. The distribution of the productive and non-productive man-days of time in this project is given below. In computing these data, no charges have been made for the time spent by the Bureau or Park Service for administration or contributed overhead.

Productive man-days	
Treating	276 Days
Spotting and Checking groups	7 "
Mixing spray materials	7 "
Total	290 Days

TABLE 3. LINEAR FEET OF TREES TREATED IN INFESTATION GROUPS BY SPECIES AND METHOD OF TREATMENT

Group	Linear Feet Treated																								
	Western White Pine			White Bark Pine			Lodgepole Pine			Ponderosa Pine			Engelmann Spruce			Total for Group	Total Linear Feet Treated			Total
	Oil	Peel	Burn	Oil	Peel	Burn	Oil	Peel	Burn	Oil	Peel	Burn	Oil	Peel	Burn		Oil	Peel	Burn	
A						1,384										1,384			1,384	1,384
B				47												47		47		47
F				135												135		135		135
H	1,430						56									1,486	1,486			1,486
L	60						34									94	94			94
M	2,273	188														2,461	2,273	188		2,461
Q	1,061	267	738													2,066	1,061	267	738	2,066
S	2,344	746														3,090	2,344	746		3,090
T	87	125														212	87	125		212
U	1,547	66											137			1,750	1,684	66		1,750
V	2,746		1,097													3,843	2,746		1,097	3,843
W	1,460															1,460	1,460			1,460
X	1,262	1,074														2,336	1,262	1,074		2,336
Y	641	962											66			1,669	707	962		1,669
Z	710	2,029						58		56						2,853	710	2,143		2,853
AA							157	34					26			217	183	34		217
BB	63												64			127	127			127
CC	115															115	115			115
DD		40														40		40		40
EE		221														221		221		221
FF				495												495		495		495
GG						806										806			806	806
Total Feet	15,799	5,718	1,835	677	2,190		247	92		56			293			26,907	16,339	6,543	4,025	26,907
% of Total	58.7	21.3	6.8	2.5	8.2		0.9	0.3		0.2			1.1			100	61.0	24.1	14.9	100
Total for Species	23,352			2,867			339			56			293							26,907
% of Total	86.8			10.6			1.3			0.2			1.1							100

Non-Productive man-days

Kitchen (Cook and Flunky)	101 Days
Supervision (Hamilton)	43 "
Lost due to rain	31 "
Shoveling snow from road	5 "
Total	180 Days

Number of trees treated per man-day	1.87 trees
Linear feet treated per man-day	97.5 feet
Number of days when treating was done	31 days
Number of days when oil was mixed	3 "
Number of days when groups were checked	5 "
Number of days lost due to rain	3 "
Number of days spent on road work	1/2 "

Cost of the 1945 Project

The total costs of the 1945 project are difficult to determine and are not exactly comparable to those of former projects in the White River District or in other districts of the Park. As in other projects, the highest charge is that against the actual treating work and for the 1945 project this was assumed. There was no charge to the Park Service for the C. P. S. crew, except that transportation of 12 men from the main camp in Sequoia National Park and return was paid by the Park Service and meals were furnished without cost to the men. In evaluating the services of these men, the Park Service assumed a rate that would have been paid for hired laborers. This rate was $7.76 per day ($0.97 per hour including overtime). Using this, and other rates prepared by the Park Service, the following project costs have been computed:

Overhead

Project Superintendent -	$155.00 per month plus overtime	$282.87	
Cooks	$7.00 & $6.25 day plus overtime	403.51	
Flunky	$7.76 per day including overtime	372.48	
			$1,058.86

Control Work

Treating -	276 man-days at $7.76 per day	$2,141.76	
Checking	7 man-days at $7.76 per day	54.32	
Mixing materials	7 man-days at $7.76 per day	54.32	
			2,250.40

Materials

Orthodichlorobenzine -	115 gal. at $1.125/gal.	129.38	
Fuel oil	460 gal. at $0.075/gal.	34.50	
Gasoline and oil	(assumed)	50.00	
			213.88

Total Cost of 1945 Project $3,523.14

Cost Per Treated Tree	$6.82
Cost Per Productive Man-Day	12.15

Compared with the charge of $2.09 per CCC man-day used to compute total costs for several former projects in the Park, the costs of the 1945 project are exorbitantly high. However, on an actual cost basis, it is believed that the 1945 project would have compared favorably with past projects.

RESULTS OF THE 1945 CONTROL PROJECT

The determination of the total effectiveness of the oil spraying project, by measuring mountain pine beetle mortality, is not an easy task. One of the biggest obstacles in such a determination is the length of time between the treatment and final mortality, due primarily to the delayed action of the spray mixture. In this particular project it was very pronounced.

It is regretted that final results of the 1945 project cannot be given at this time. The trees showing a high survival should be re-examined to determine subsequent mortality and the groups of trees at the higher elevation should also be examined. The press of other duties makes an examination by the writer during the summer impossible. Perhaps final mortality can best be determined in the fall when another survey of the White River Ranger District will be made.

Where the trees were peeled or burned, it is felt that 100 percent mortality resulted; however, where the trees were sprayed with penetrating oil, the results were not as conclusive when the project closed. Certain groups, chiefly S, X, Y, Z, which were below the Yakima Park road, showed a quick high mortality because they were in a more exposed situation. Other groups showed some mortality as well as living larvae after treatment. In all probability, the final mortality resulting from the spray will be high in all groups.

Mortality figures were obtained by making counts of living and dead insects in portions of the treated trees. All living insects were considered as survivors; however, it is recognized that additional mortality may occur before emergence.

Mortality Counts

The first trees to be sprayed with oil were in the V group and were treated on May 7. On May 16 several square foot samples of bark were collected in this group. The samples were taken to the dormitory at the Ranger Station and placed at room temperatures. After a few hours all the larvae in several samples were alive with no apparent

mortality, in spite of the fact that the odor of ortho under the bark was exceedingly strong. Additional samples were collected the next day and brought to Portland where they were examined by Messrs. Keen, Furniss, and Struble. The odor of ortho was very pronounced and, since some mortality of larvae and overwintering adults was evident, it was evident that there had been a delayed action of the spray. In a total of 4.5 square feet of bark collected from 4 treated trees in the V group, the following counts were made on May 19:

Larvae			Percent
Alive	Dead	Total	Mortality
117	561	678	82.7%

On May 21 another visit was made to the V group with Mr. Keen and Mr. Struble. At that time, the odor of ortho was still strong and mortality was very conspicuous and easily discerned. No actual counts were made but it was the concensus that close to 100 percent mortality would take place in the treated trees in this group. This disparity between no mortality on May 16 and high mortality on May 21 in treated trees in the same group can be explained by a change in the temperature and a delayed action of the ortho. Daily temperatures until about May 20 had been fairly low but after a few warmer days mortality began to be evident.

On June 15 a second series of bark samples from treated trees was examined in the field for mortality. From a total of 36 half-square foot samples collected from three portions of 15 treated trees in four groups, the counts shown in Table 4 were made.

TABLE 4. MORTALITY OF MOUNTAIN PINE BEETLE AS OF JUNE 15, 1945

Group	Square Feet of Bark	Larvae		Adults		Total		Percent Mortality
		Dead	Live	Dead	Live	Dead	Live	
M	1.5	195	0	18	0	213	0	100.0%
U	6.5	729	3	87	0	816	3	99.6%
X	4.5	514	3	105	0	619	3	99.5%
S	5.5	548	57	66	1	614		91.3%
	18.0	1986	63	276	1	2262	64	97.2%

Of the 63 live larvae found in these samples, 49 were found in the top of tree number 7 in the S group. There was a heavy growth of lichen and mossoon this particular top and it had been only lightly sprayed with oil. Whenever live larvae were found, that part of the tree was peeled so as to expose the insects to the elements and insure complete treatment.

While the above samples can only be taken as an indication of the results obtained, they do show that, for the most part, the spraying was effective in killing both larvae and adults. The real proof of the effectiveness of the 1945 project will be in the number of trees attacked during the coming summer and in need of treatment in 1946.

SUMMARY

The results of the 1945 control work against the mountain pine beetle in the White River Ranger District of Mount Rainier National Park are herein reported.

A total of 516 trees were treated during the period from May 7 to June 21, 1945 by a 12-man C. P. S. crew brought from Sequoia National Park for this particular project. Of the total trees treated, 417 were western white pine, 83 were white bark pine, 9 were lodgepole pine, 6 were Engelmann spruce and 1 was a ponderosa pine. The trees averaged 12.7 inches in diameter at breast height.

A total of 26,907 linear feet of infested trees was treated during the project; of which, 16,339 feet, were sprayed with a mixture of 4 parts fuel and 1 part orthodichlorobenzine; 6,543 feet were peeled; and 4,025 feet were burned. The infested length of the trees treated averaged 52.1 feet per tree.

Practically all of the trees treated in this project were spotted by Mr. Furniss and Mr. Buckhorn in September 1944 and the remainder were spotted by the writer and Mr. R. Hirchberger after the project began in May 1945.

Weather conditions were probably typical for May and June. Three days of treating time were lost because of rain. When the project began the ground was covered with deep snow which persisted in the Summerland, White River Park, and Sunrise Ridge areas throughout the project. The presence of snow made transportation of the men and spray mixture difficult.

Final results of the 1945 project cannot be given at this time. Mortality figures indicate that upwards of 95 percent mortality reculted from spraying the bark of infested trees. Where the trees were peeled or burned, 100 percent mortality resulted.

It is felt that the use of penetrating oil sprays against the mountain pine beetle in the Park gave very satisfactory results and can be used with confidence in future control projects.

CONCLUSIONS

In spite of the fact that the final results of the 1945 penetrating oil spraying project in the White River Ranger District cannot be given at this time, it is the opinion of the writer that very satisfactory results were obtained. It is felt that the 1945 project will be fully as successful, if not more so, than past projects in this district. Considering the writers inexperience in this method of control, the weather conditions, the topography and working conditions, it is felt that the 1945 project will be as satisfactory as could be expected.

Our goal was 100 percent mortality and where the trees were peeled or burned this goal was achieved; however, where the trees were sprayed it is felt that the mortality will probably average between 95 and 100 percent. It can be concluded that this project successfully demonstrated the feasibility of using penetrating oil sprays as a control method against the mountain pine beetle in white pine in Mt. Rainier National Park. It is certainly the easiest of the three methods tried, once the trees are felled and the oil is at the group to be treated. This method was not used on white bark pine but it is probable that equally good results can be obtained after the trees are limbed.

With a smaller proportion of orthodichlorobenzine in the spray mixture, it will be possible to reduce the costs of the spray and the cost of treating each tree without reducing the effectiveness of the spray.

Although somewhat experimental, it is believed that penetrating sprays, if properly applied on dry bark, can be used with confidence in the future control of the mountain pine beetle in Mount Rainier National Park.

RECOMMENDATIONS

In view of the experiences gained during the 1945 project, the following recommendations are offered for the benefit of future control projects in the Park:

1. A survey of the White River Ranger District should be made in the fall of 1945 to determine the need for maintenance control work in the spring of 1946.

2. At the same time, final checks on the mortality of mountain pine beetle in the trees sprayed in 1945 should be obtained.

3. If control work is deemed necessary in 1946, the project should be set up as an oil spraying project but the actual treating work should be delayed until most of the snow has melted from the largest portion of the area. The spray mixture appeared to be more active during warm weather. Travel and transportation problems would be much simpler if the project was delayed.

4. Wherever possible, horses should be used to transport the spray mixture from the truck to the groups of trees to be treated.

5. In view of the success of the 1945 project, it would be advisable for the Park Service to purchase at least 3 compressed air sprayers, with a capacity of 4 gallons each, to have on hand for this particular type of work. These sprayers worked very well and until some other method of applying the oil has been worked out, it would be well to have this equipment on hand. In addition, it would be advisable to purchase several feet of oil-resistant hose and a supply of extra

washers and tank gaskets. In this respect, Mr. Evenden of the Coeur d'Alene laboratory reports that the D. B. Smith Co., Utica, New York, make an oil-resistant hose (Mainstay) and washers and gaskets from "Thiokol". He also recommended an extension strainer made by the same company that should be used with these sprayers.

MAP 1. LOCATIONS OF GROUPS OF TREES TREATED IN 1945

The letter indicates the group of trees and the figure within the circle indicates the number of trees treated in that group.

GRAND PARK
Cold Basin
Landslide
Slide Mtn
Burnt Park
Bear Park
Brown Pk
Green Park
The Palisades
Hidden Lake
Marcus Pt
Prospector Cr
HUCKLEBERRY PARK
Huckleberry Creek
Lost Creek
McNeeley Pk
Forest Lake
Mt Fremont
SOURDOUGH MOUNTAINS
WHITE RIVER PARK
Clover Lake
Sunrise Ridge
Frozen Lake
Sunrise Lodge
Yakima Park
Shadow Lake
Dege Pk
State Highway Maintenance Camp
White River Entrance Ranger Station
WHITE RIVER
MEMORIAL
White River
Patrol Cabin
Baker Pt
GOAT ISLAND MTN
Shaw Creek
Tamanos Mtn
Shelter Cabin
Owyhigh Lakes
Barrier Pk
Sheepskull Gap
Yakima Pk
Cayuse Pass
Deadwood Lakes
Summerland
Fryingpan
Sarvent Glaciers
Panhandle Gap
Banff Pk
Shelter Cabin
Needle Creek
Kotsuck
Boundary Cr
Ohanapecosh Park
Boulder
Falls
Patrol Cabin

volcano that stands in its center and occupies
Mount Rainier, known also by the Indian name
ated on the western edge of the Cascade Range,
f Seattle and Tacoma and the entire Puget Sound
ak has become known the world over as the most
Pacific Northwest. To the north and the south
other snow-capped volcanoes, notably Mounts
ms (12,307 feet), St. Helens (9,697 feet), Hood
(14,162 feet), each remarkable for its height and
er surpasses them all: it is the loftiest and most
in the United States, outside of Alaska.
Rainier, as determined by special measurements
the topographic surveys for this map, is 14,408
ghest mountains in the United States, but it is
ice thought, being overtopped 93 feet by Mount
and 12 feet by Mount Elbert, in Colorado.
owever, projects more than a few thousand feet
ich it stands, whereas Mount Rainier towers as
0 feet above the sky line of the Cascade Range.
ered doubly impressive by the vast extent of its
wn to base it is enveloped in masses of perpetual
e bolder cliffs and crags. Together these glaciers
miles, or more than twice the total area of the
National Park. No other single peak in the
Alaska, carries a system of glaciers so extensive.
mountain, between its snow fields and the forests,
quisite charm, more picturesque than any parks
ardener, more thickly studded with flowers than
ws of Switzerland. These attractive spots afford
grim ice-covered peak above and greatly add to
this scenic region. Thousands of persons flock
camp and to engage in mountaineering sports.
e Mount Rainier National Park is reached by auto-
way that begins in the city of Tacoma, 56 miles
Seattle, and other Puget Sound cities are on the
xtends from Vancouver to Tia Juana and makes
to the entire Pacific coast. From the park en-
oad leads 20 miles to Paradise Valley. The east
d from Yakima by about 80 miles of paved and
ards, dense forests, and canyons. Paved roads
oads reaching the park on the north and south.
f Tacoma, Seattle, and Yakima, which are reached
ads, stages of the Rainier National Park Co. run

region.—The Rainier region is a land of rugged
ested valleys—a wilderness that has scarcely felt
for the few roads that have been built through
aly routes of communication, and transportation
accomplished by saddle and pack train. The
stations, and a miner's cabin here and there are
ations.
gly well watered, dozens of turbulent rivers and
ice fields of the central peak. It is no exaggera-
eams afford obstacles to travel more serious even
ecially is this true on warm summer afternoons,
greatest melting power on the glaciers. The
ing torrents of liquid mud in which cobbles and
as they are swept along. Yet at daybreak these
clear streams, of moderate volume, not difficult to
tions are often as great in degree as the seasonal
where.
ny of the peculiarities of the Rainier region are
e. No other part of the United States except
west of Puget Sound, and the Alaska coast,
precipitation. The annual total is considerably
about double that received by the moister por-
of it falls in the form of snow. At Longmire, in
itude 2,700 feet), the snow on the ground some-
6 or 7 feet, and the total snowfall during the

snow to melt away but boldly come up through the margins of the drift
melting holes through snow several inches deep.

The trees of the subalpine zone, like the flowering plants, belong
types especially adapted to the rigors of a mountain climate. Few
them are more than 60 or 70 feet high, and they have stout, strong
tapering trunks and resilient, drooping branches that quickly shed the
load of snow. The most common species are the subalpine fir, su
alpine hemlock, and the Alaska cedar. At the higher levels only th
subalpine hemlock and white-bark pine manage to hold their own, growi
in permanently bent or entirely prostrate forms. A timber line in th
true sense does not exist, but straggling trees take advantage of favorab
spots as high as the edges of the snow fields.

The fauna of the subalpine zone is as highly specialized as its flor
Noteworthy among its inhabitants are the white mountain goat, often se
grazing in small families or bands; the whistling marmot, a burrowi
rodent as large as a beaver, whose piercing note is one of the famili
sounds in the lower meadows; and the "least hare," or coney, a smal
short-eared rabbit, whose shrill squeak comes from under the rock piles
the bases of cliffs. Numerous grouse make their homes in the tree clump
and broods of ptarmigan (a kind of grouse that is white in winter) may
frequently seen on the rocky crests overlooking the glaciers.

Alpine zone.—Most of the higher crests and ridges within the Mou
Rainier National Park reach up into the subalpine zone, but only a few
their highest crags rise above it and bear snow banks throughout the sur
mer. Mount Rainier itself, on the other hand, stands almost wholly in th
zone of perpetual snow, and its climate may be described as that of conti
uous winter. Practically all precipitation, even in summer, consists of snow
and freezing temperatures prevail throughout the year. Up to altitud
of about 10,000 feet the temperature of the air on summer days may ri
appreciably above the melting point, yet frost sets in almost immediate